# A Novel Single Frequency, Pulsed UV Source For Airborne Direct Wind Lidar

Johann Thurn*, Raoul-Amadeus Lorbeer, Peter Mahnke and Oliver Kliebisch
German Aerospace Center | Institute of Technical Physics | Pfaffenwaldring 38-40 | D-70569 Stuttgart
*johann.thurn@dlr.de

We have conceptualized a compact UV source with pulse parameters optimized for airborne clear air turbulence detection. An amplified single frequency 10 ns-Nd:YAG source is to be frequency-tripled to 355 nm, > 2.5 W at 3 kHz pulse repetition frequency.

## Motivation

Early detection of clear air turbulence for

- energy-efficient and
- comfortable flight

About 10% savings in aircraft weight can reasonably be expected due to lighter wing geometries.

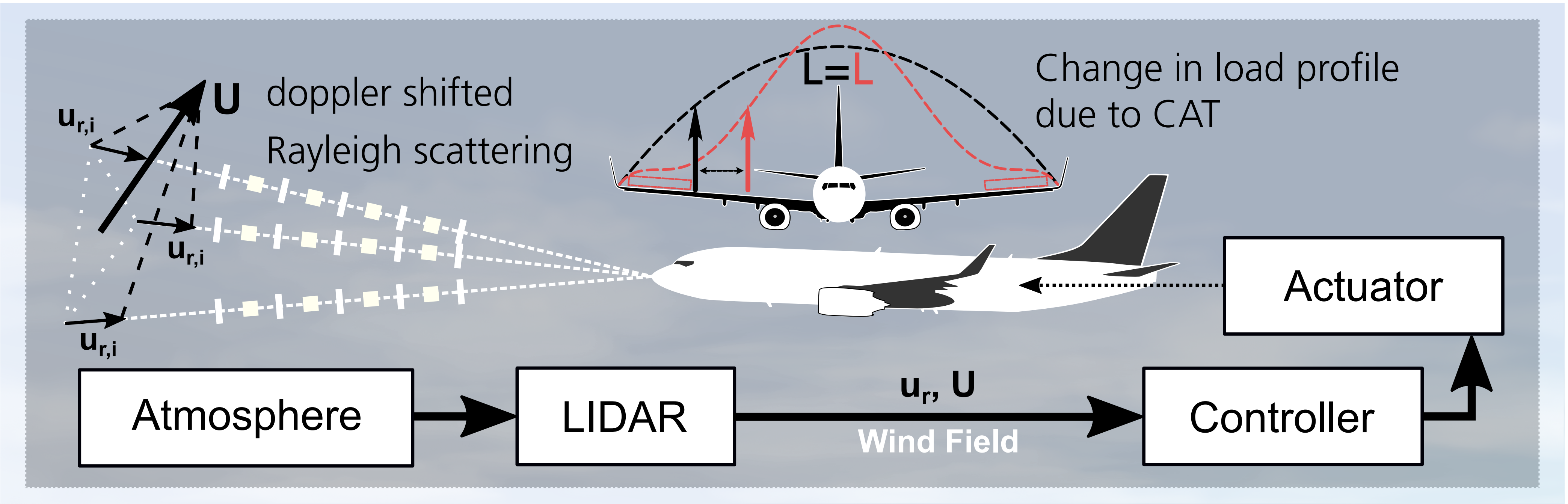

**Fig. 1** - Controller scheme

## Objective

Build laser with parameters

- tailored to an existing direct detection wind lidar (DDWL) based on a Michelson interferometer
- optimized in lidar simulations

Optimal parameters are as in the abstract

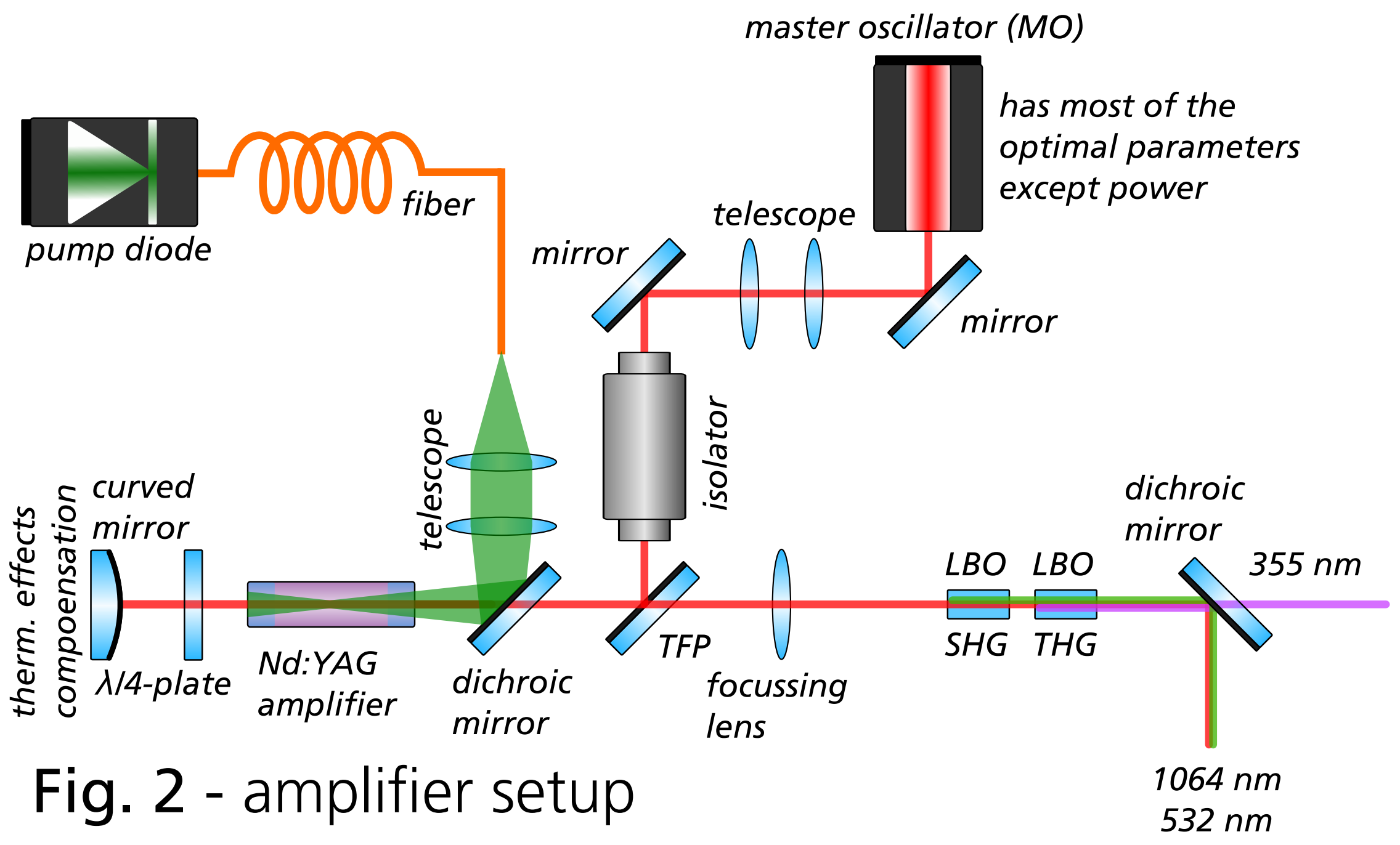

**Fig. 2** - amplifier setup

The pump multimode fiber is imaged in to the amplifier rod using a f = 35 mm collimator and a focussing lens. The Master oscillator (MO) is overlapped with the pump spot using a telescope.

## Challenges

The most prominent challenges are

- thermal effects like lensing and depolarisation due to high pump power
- laser induced damage on optical surfaces due to high fluence
- efficient conversion to 355 nm

Measures to reduce thermal lensing:

- endcaps to reduce bulging
- stepwise increase in doping
- larger pump spot

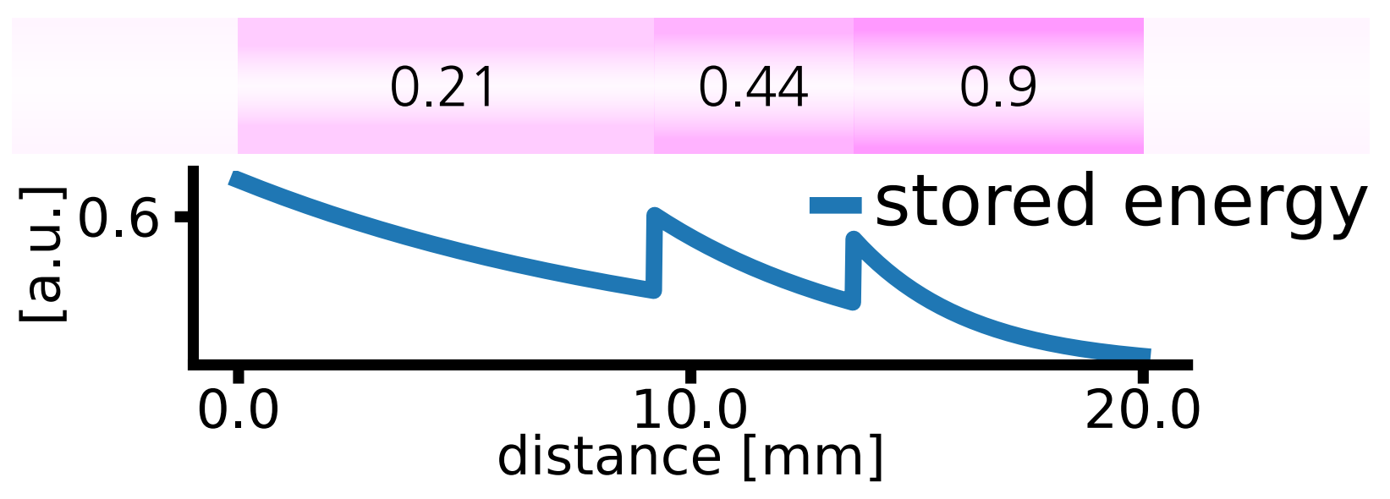

**Fig. 3** - amplifier rod with stored energy

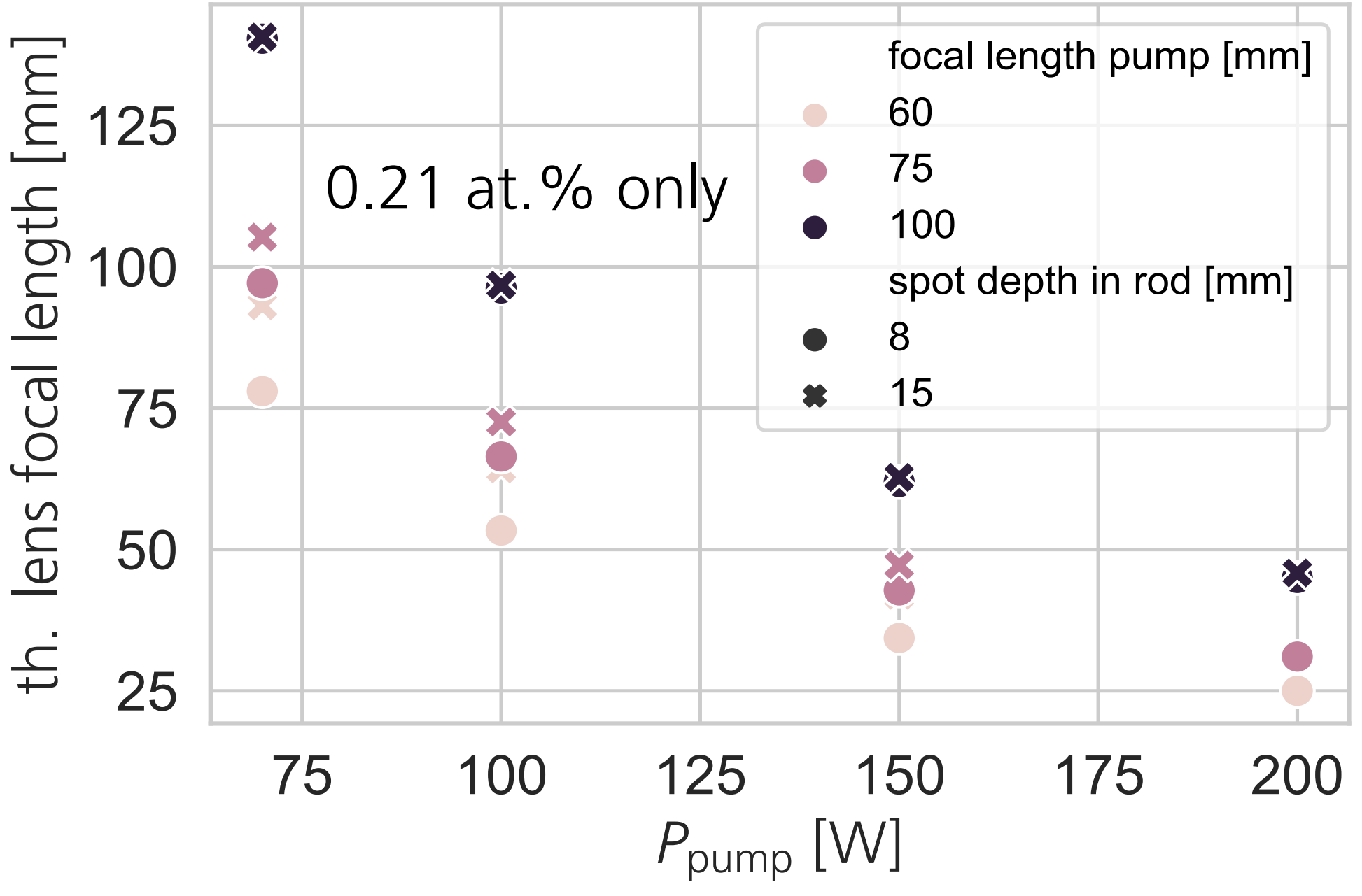

**Fig. 4** - calculated thermal lens (LASCAD$^{TM}$)

## Current status

- not saturated yet, stronger MO will yield more output
- increasing output power will yield efficient conversion to 355 nm as seen in comparison with 100 Hz test system
- thermal lensing hinders finding an ideal operating point due to short focal lengths (< 50 mm)

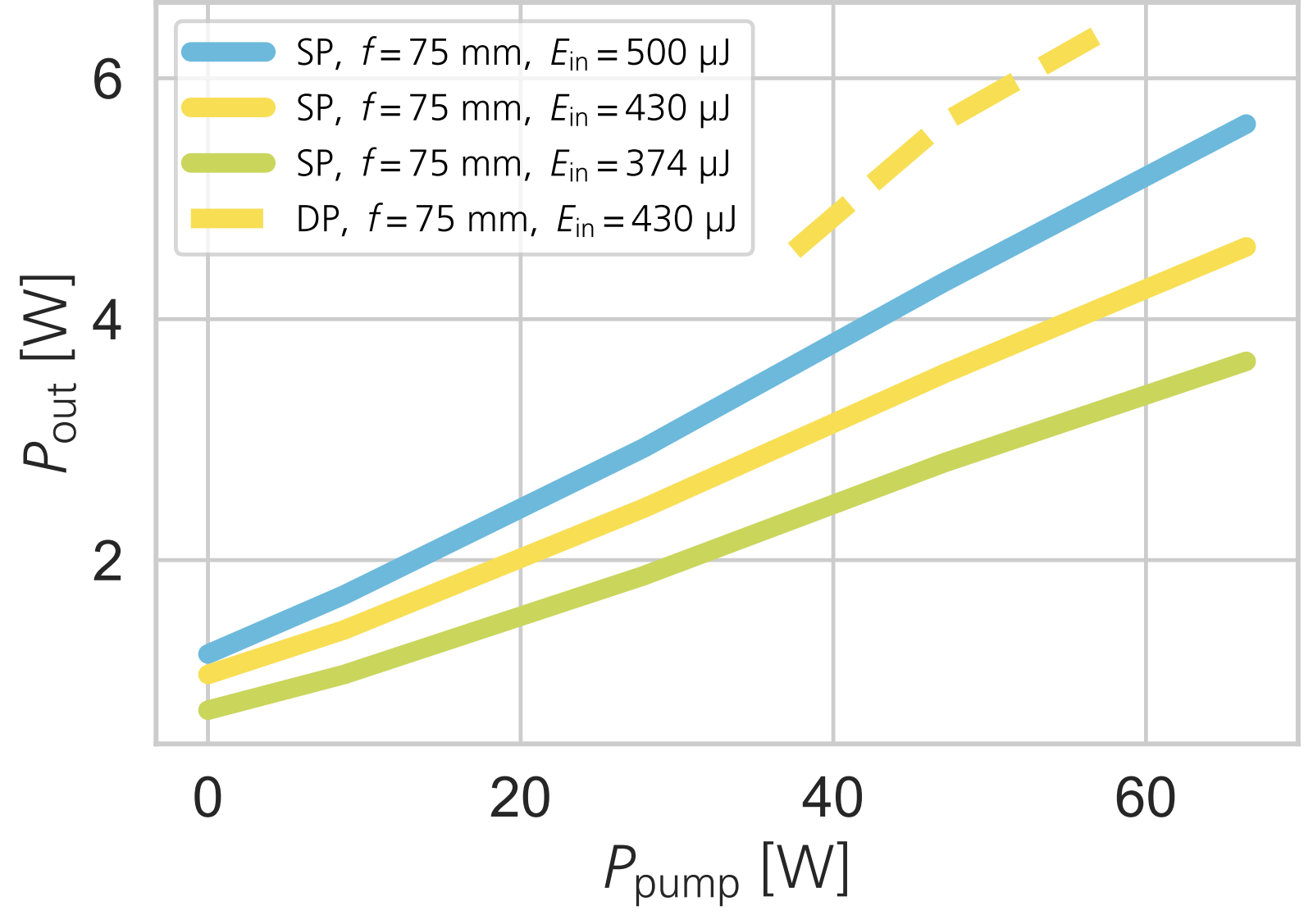

**Fig. 6** - output power vs pump power

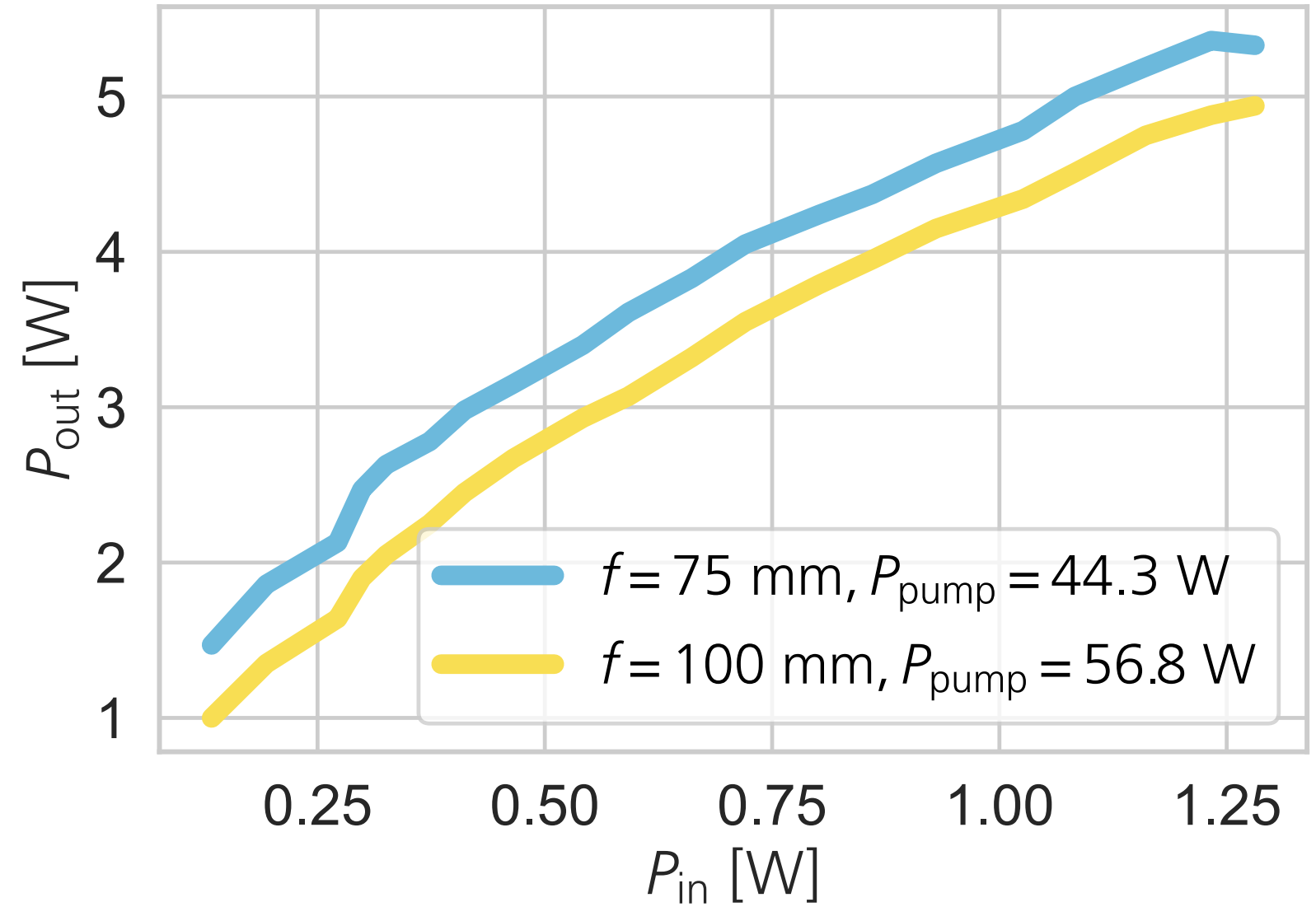

**Fig. 7** - double pass output vs input

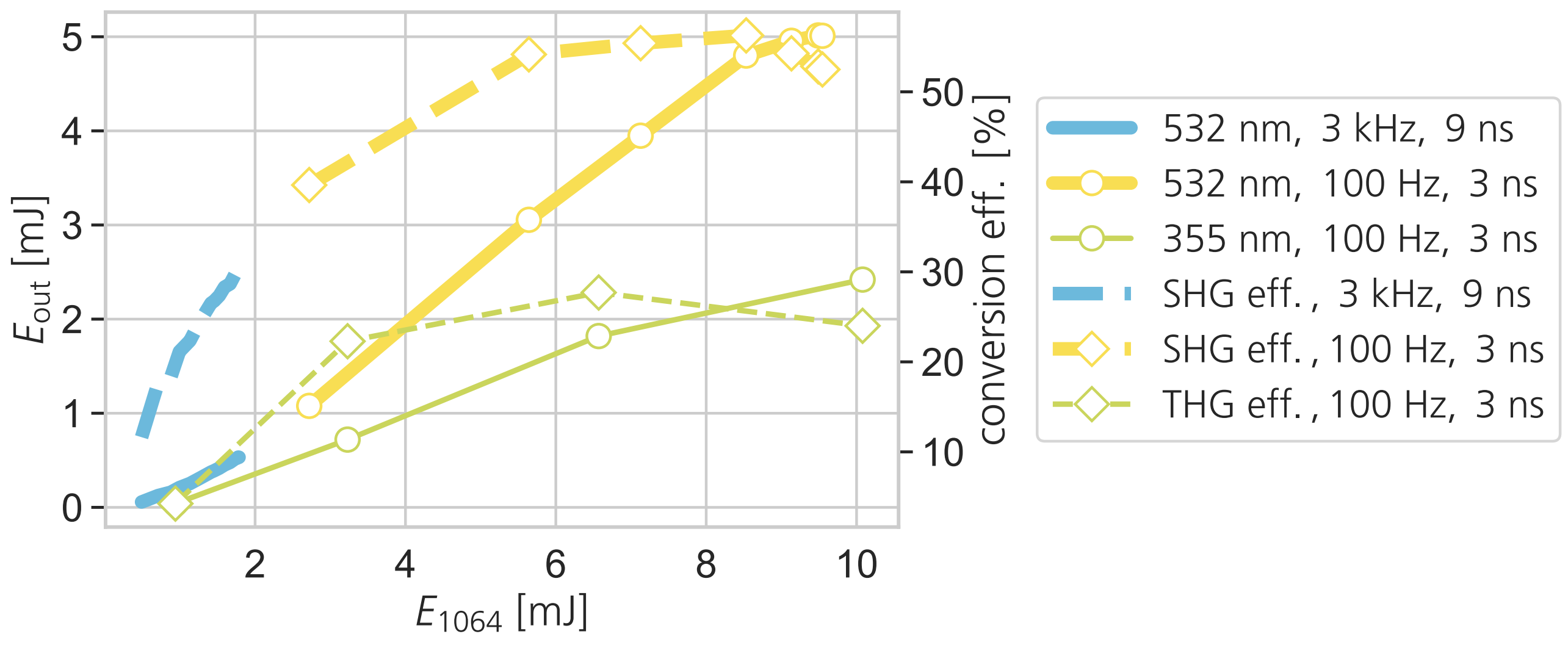

**Fig. 5** - comparison of second/third harmonic generation at 3 kHz vs. 100 Hz test system

## Future improvements

- smaller radius of curvature on double pass mirror
- reverse pumping scheme for less components in high power path and more suitable position of thermal lens

DLR